Work Group Questions

PSTN Transition Issues Work Group

The *PSTN Transition Issues* Work Group will focus on identifying and evaluating issues that arise out of the shift in voice service usage patterns. As consumers and businesses use different networks and infrastructures to meet needs traditionally served by the PSTN, a variety of challenges emerge. Particular services provided by the PSTN may not transition well to successor networks, and certain users may not be in a position to transition easily. At the same time, transition might otherwise yield great benefits. Methods and practices, including interconnection, numbering, and database standards, may need to evolve for successor networks to retain crucial aspects of the functionality of the current circuit-switched network. The work group will make recommendations to the Commission to help address the transition from the circuit-switched to successor, packet-switched networks.

Questions for Consideration by PSTN Transition Issues Work Group:

1. Copper Retirement
    - What services remain dependent upon the existing twisted-pair copper plant? What services may no longer be available if twisted pair copper is no longer offered from customer premises to the wire center? What non-voice services and features will not work without modification in an all IP-based network?
    - What substitutes exist for services that may not be able to transition from the analog circuit-switched network? What is the cost or technological impact of the substitute?
    - As landline voice service decreases, what fraction of copper loops is left idle, rather than serving as DSL loops or being put to other use? How is non-voice demand for copper loops expected to change over 5-10 years?
    - Are there practical uses of abandoned copper and if so, what are the uses, and what are the costs (or cost drivers) and technological impediments to putting such copper to use?
2. PSTN Users
    - What technologies might encourage or ease transitions to IP-based networks for consumers, especially those who might otherwise find a transition disruptive?
    - For consumers who only want to pay for a fixed voice connection, are there cost-effective mechanisms for supplying that connection if there is no circuit-switched last mile, such as standalone managed VoIP service over DSL or fixed wireless service? What are potential issues when running VoIP over (fixed) LTE, whitespace wireless, or other fixed wireless access solutions?
3. Interconnection Group A
    - What methods have evolved for the exchange of traffic in the hybrid IP-based/circuit-switched network? How will those methods transition as the network shifts to being wholly IP-based?

- How might interconnection requirements and provisioning evolve as consumers adopt new communications technologies, such as HD voice or video?

4. Database Transition Group A
    - What legacy databases will need to transition to a future all-IP environment?
    - How will databases that are essential to the operations of the PSTN need to evolve to operate in an IP-based network?

PSTN Successor Infrastructure Work Group

The *PSTN Successor Infrastructure* Work Group will focus on identifying key elements essential to an IP-based real-time communications infrastructure. As consumers and businesses turn to other networks to replace functionality previously provided by the current voice network, questions arise as to how those networks can replicate the best characteristics of the circuit-switched network while taking advantage of their advanced technological underpinnings. Successor networks face new quality-of-service and robustness challenges. They may depend upon new databases and take advantage of new interconnection standards. The work group will look past the challenges of transitioning from the legacy circuit-switched network, and focus on the technical characteristics and user experience of successor networks. The work group will make recommendations to the Commission to identify challenges to the effective performance of successor networks.

Questions for Consideration by PSTN Successor Infrastructure Work Group:

1. Interconnection Group B
    - Do technological interconnection issues exist at higher protocol levels, e.g., SIP?
    - What architectures might evolve to support VoIP interconnection and interconnection of advanced communications services? How would architectures function at different network layers (e.g., MPLS, IP, SIP)?
    - Develop a detailed matrix of technical issues that need to be worked out for an IP interconnection framework, the entities who would need to be involved in each aspect, and preliminary thoughts on possible technical solutions.
2. Numbering Group B
    - What changes might be expected in a numbering plan optimized for IP-based communications services? (For example, current numbering systems are tied to physical resources, such as lines, and are often service specific, e.g., SMS short codes.)
        - What are the obstacles to assigning numbers to users, analogous to how domain names are assigned, rather than to service providers?
        - Should number assignment need to retain a geographic component? For example, do numbers still need to be assigned to specific rate centers in an all-IP world?

        - How can the receiver of a call validate that the caller is authorized to use the number or other identifier ("caller ID validation")?
        - What role is ENUM going to play as a number mapping service as the numbering system evolves? Is there a need for additional or alternate solutions?
    - How might technological changes drive signaling requirements and number translation capabilities?
3. Database Transition Group B
    - What new databases or database architectures will be necessary or helpful in an all-IP network?
    - To what extent are these new databases already developing? Who is developing them? What challenges does their development face?
4. Quality of Service
    - How will the use of end-to-end IP connectivity impact QoS? Is there a need for defined call quality metrics? How can we properly measure and assess the difference in QoS in IP service relative to circuit-switched service? What are the complexities associated with measuring IP QoS?
    - What entity or entities can best perform reliable, unbiased and comprehensive QoS testing? Can this be done by industry and/or government groups or labs and if so, do such groups/labs exist already?
    - Can end-to-end QoS be provided across service providers? What models seem possible (e.g., DiffServ, resource reservation, separate physical, or L2 networks)?
    - How would the use of multiple media (high-quality audio, video) impact QoS considerations?
5. Robustness and Public Safety
    - How will the transition affect network robustness?
    - What will robustness likely improve or degrade in the transition?
    - What technologies can improve network survivability? How effective are these technologies likely to be compared to existing PSTN survivability?
        - Wireless
            - Backup power at base station and handsets?
            - Capacity vs. footprint tradeoffs
        - Wireline
            - Backup power for both the network and home or small business environments?
    - What, if any, additional capabilities are needed from the underlying broadband network to enable 911 or other emergency services functionality that is at least equivalent to that offered by the existing system?

Receivers and Spectrum Work Group

The *Receivers and Spectrum* Work Group will tackle the issue of the role of receivers in ensuring efficient use of the spectrum and how to avoid potential obstacles to making spectrum available for new services. Efficient use of the spectrum is a function of both transmitters and receivers. Transmitters can be a source of interference by emitted unwanted energy into spectrum used by other services. Receivers may prevent the use of bands if they pick up signals outside the spectrum bands they are authorized to use. While the Commission has focused primarily on transmitters, the need to address issues relative to receivers is becoming increasingly important. Various approaches have been suggested ranging from development of receiver standards to policies that define the expected interference environment and hold parties accountable if they choose not to design for that environment. This work group is tasked to study this issue and develop options and recommendations for dealing with it.

Questions for Consideration by Receivers and Spectrum Work Group:

1. What resources are available on the performance of receivers, particularly relative to adjacent channel rejection?
2. What are the gaps in what is known about receiver performance, particularly relative to particular services that rely on reception of weak signals such as radar and satellite services?
3. What work should be undertaken to close these gaps?
4. Who should perform this work and what role should the FCC play relative to closing the knowledge gaps relative to receiver performance?
5. How can information about receiver performance be made more transparent to prospective users of spectrum that is a candidate for repurposing?
6. To what extent is it important to have access to such information for federal systems?
7. To what extent do national security concerns come into play in making information available about receiver performance for both federal systems and non-federal public safety and critical infrastructure systems?
8. What particular parts of the spectrum are of greatest priority for study of receiver performance and how it might affect access to spectrum for new services?
9. What approaches might be used as an alternative to specifying receiver standards, such as better defining the environment in which services and devices are expected to operate?
10. Can receiver issues be addressed more effectively in the private sector or through private-public collaboration and what specific steps might be taken to do so?
11. How might the FCC best approach receiver performance from both a technical and policy perspective?
12. If performance metrics were established for receivers, what parameters should be subject to these metrics and how should criteria for performance be derived?
13. What approaches should be taken relative to receivers that do not conform to the metrics?
14. How should the Commission address situations where there is a significant issue relative to legacy equipment? For example, should the FCC establish transition

15. What is the estimated magnitude of the current receiver based spectrum efficiency impact, i.e. how many different areas are impacted or may be impacted in the near future based on changes in spectrum utilization and what is the level and nature of the impact and the required resolution?
16. What is the relationship between receiver performance and the various proposals for spectrum sharing?

Multi-band/Multi-mode Devices Work Group

The *Multi-band/Multi-mode Devices* Work Group will study the challenges in developing equipment that is capable of supporting multiple radio interfaces over numerous frequency bands. For example, the 3GPP has identified more than forty band classes that have been identified internationally for commercial wireless services and the number will inevitably continue to grow as more spectrum is identified for use by these services. Also, most smart phones support GPS, WiFi, and Bluetooth technologies. In addition, RFID and near-field communication capable smart phones are being introduced to the market place. Wireless operators are pressuring manufacturers to deliver global phones to capture high-end customers with ever-increasing number of applications utilizing various radio interfaces. Equipment manufacturers can be faced with difficult design trade-offs as to how many and which bands to include in any given device. These decisions may take into account factors such as the effect on battery life, antenna efficiency, filter technology and available "real estate" on the circuit board. This work group will consider what the gaps are today between the need to operate across a diverse set of frequency bands to meet the demand for wireless broadband services and the limitations of available technology. The group is to define the scope of this problem and what, if anything, the Commission can do to address it.

Questions for Consideration by Multi-band/Multi-mode Devices Work Group:

1. What are the challenges that face commercial wireless service providers and equipment manufacturers in providing service across multiple frequency bands and multiple mode of operation?
2. How are they approaching these challenges? For example, are the carriers and equipment manufacturers forced to choose which bands they will cover in any particular area or device based on technical limitations? How is interoperability managed for multiple-mode of operation?
3. How will these challenges become more difficult or easier in the near term and long term future?
4. What are the challenges relative to filter technology both from a transmitter and receiver standpoint?
5. What are the challenges relative to antenna technology?

6. How do these various factors affect performance and quality of service? For example, does the need to operate across multiple bands necessarily lead to compromises in the ability to receive weak signals or reject interference?
7. Are challenges mostly on hardware? Any firmware challenges such as preferred system acquisition?
8. What is the impact on battery life?
9. What are the limitations today on the frequency range that can be covered by a multi-band device? How might they change in the future?
10. How would the availability of frequency bands above 3 GHz for small cell deployment such as the 3550 – 3650 MHz band or the 5 GHz Wi-Fi bands affect the availability and use of multi-band devices covering these frequency ranges?
11. How will the availability of new spectrum in the 600 MHz range recovered through a voluntary incentive auction affect the design and availability of multi-band devices?
12. What is the process of Multi-band/Multi-mode device certification and type approval process? Is there a room for improvement?

Wireless Apps and Services Work Group (M2M)

The *Wireless Apps and Services* Work Group will continue and build upon the good work of the previous TAC's Sharing Work Group on reducing application friction points. That group had a number of recommendations: Sponsor a mobile application developer conference; encourage formation of community of interest groups that can drive standardization (existing/new); encourage carriers to establish common practices/set of network interfaces; commission a user-friendly led analysis of key building blocks; and conduct a focused "friction point" analysis of key vertical industries such as critical infrastructure/utilities, public safety, and health care. The area of wireless apps and M2M services and devices has been a remarkable success thus far. The task of this work group will be to carry out the recommendations from the prior TAC and explore and make recommendations on related issues such as the impact of the growth of these services on networks and the demand for more spectrum.

Questions for Consideration by the Wireless Apps and Services Work Group:

1. What is the experience thus far in the development of wireless apps and services?
2. What obstacles have been encountered by carriers, innovators and users in the introduction of these services?
3. What are the current friction points relative to the availability of wireless apps and devices for health care? For energy? For education? Public safety?
4. What specific steps can be taken to reduce or remove these friction points?
5. What are the principal M2M applications today?
6. What impact are those M2M applications having on the networks?
7. What is the projected growth of M2M applications and what impact are they expected to have on the networks in the future?

8. Are particular M2M data hungry applications such as video surveillance and monitoring anticipated to have a particular impact on the networks? If so, how will they be dealt with?
9. How does the current industry process work for approval of new apps and M2M services & devices?
10. Do the carriers have any pre-defined boundaries or parameters necessary to obtain approval of wireless apps, services and devices?
11. Are there things the industry can do to improve this process?
12. What can the FCC and other federal agencies do to improve the availability of new wireless apps, services and devices?
13. What privacy issues exist in the introduction and operation of wireless apps and services? What existing regulations affect such issues? How should industry standards and practices be developed to ensure that the rights of users are protected?
14. What capabilities exist in the design of standard application platforms such as IOS, Android, and Windows 8 to ensure appropriate privacy of end user data?

Wireless Security and Privacy Work Group

The *Wireless Security and Privacy* Work Group will examine the security vulnerabilities of the air interfaces used by commercial wireless networks, how they are being addressed and what role, if any, the Commission should play on this issue. As our nation relies increasingly on commercial wireless networks for safety of life and property and applications that are vital to our national economy, we must ensure that they are not open to attack. The work group will help inform the Commission as to what vulnerabilities may exist with regard to the air interfaces, including but not limited to issues such as jamming (denial of service to others), theft of service and privacy violations (snooping). The group could in coordination with the TAC expand to vulnerabilities beyond the air interface or commercial wireless networks if it believes this is appropriate. The work group will report on its findings and make any recommendations to the Commission it believes are appropriate.

Questions for Consideration by the Wireless Security and Privacy Work Group

1. What are the chief areas of concern relative to the security of commercial wireless networks, and how would you prioritize them and why?
2. What are the most significant security vulnerabilities associated with cellular and WiFi air interfaces, and how effectively have they been addressed?
3. Recognizing that today's mobile communications devices house multiple transceivers operating on multiple bands, what are the security vulnerabilities associated with multi-band devices, and how effectively have they been addressed?
4. What are the security features of today's wireless networks?
5. What are the future security features expected for wireless IP-based technologies?
6. What is the scope of potential vulnerabilities? For example, could security vulnerabilities lead to service outages? Hacks of private information?

7. How does the industry identify breaches in security?
8. What response systems are in place for dealing immediately with security attacks?
9. Are different levels of security available to users depending upon the type of application? For example, can public safety or critical infrastructure applications be provided with greater security than an ordinary smart phone?
10. To what extent is jamming a concern and what has the experience been thus far? What is and can be done about this?
11. To what extent is theft of service a concern and have there been instances where this has occurred already? What can and is being done about this?
12. What are the most significant privacy issues from a wireless technology point of view, and how should they be addressed?
13. What steps should be taken to ensure that the security capabilities, including security settings, of mobile communication devices are not compromised, either by an infectious code or user error?
14. What roles should the FCC and other federal agencies play in these areas?